No. 2015_2_05

Reconstruction of Historical Hardwood Stand Structure in Northwestern New Brunswick

Institut de recherche sur les feuillus nordiques Inc.
Northern Hardwoods Research Institute Inc.

September 2015

Technical Note

Silviculture

Introduction

Northern hardwood forests have undergone intensive cuttings over past centuries that have altered the structure and composition of these forests. To implement successful management strategies in current stands, forest managers need to understand the historical characteristics of these forests. For example, identifying the consequences of past silvicultural activities, and the evolution of structural and compositional characteristics would help forest manager develop management interventions to restore forest conditions. However, our understanding regarding historical forest characteristics and species growth patterns in northwestern New Brunswick is generally limited. Reconstruction studies are thus needed to understand how stands and species in northwestern New Brunswick have evolved in the era of continued silvicultural activities. The objectives were to: 1) evaluate structural and compositional of 1996 pre-harvest, 2) evaluate the structural and compositional changes in these stands, and 3) examine the growth patterns of sugar maple, red maple, and yellow birch in the stands.

Highlights

- ***Stands treated more than 20 years ago had high tree density and DBH > 50 cm trees formed a structurally important component of the stands.***
- ***Maintain a residual stocking level ≥ 16m ^{2}/ha to ensure a balanced and sustainable multicohort stand in the future.***
- ***Thin out long suppressed sugar maple trees with evidence of defect as they have the tendency to develop into poor form and high risk***

Methodology

We sampled three stands in northwestern New Brunswick that had the same previous and last harvest treatment years. A 3M BAF prism was used to sample all live trees and snags with diameter at breast height greater than or equal to 10cm and stumps. Annual growth-ring records were used to reconstruct the DBH of trees to the year when they reached breast height. The reconstructed DBH was used to estimate pre-harvest basal area and number of trees per hectare. Regressions of the logarithmic scale for number of trees per hectare on DBH, DBH^2, and DBH^3 were used to evaluate the shape of diameter distribution for each stand.

Reviewed: May 2018

Results

Figure 1: Trees density of historical 2012 (current) stands by site and species.

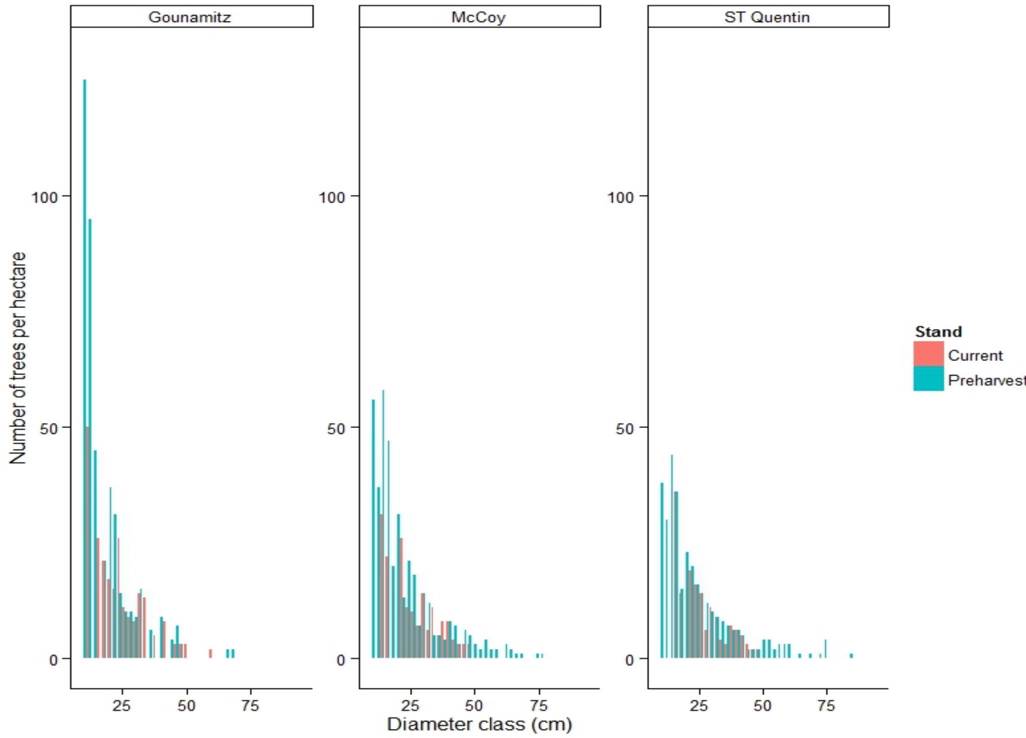
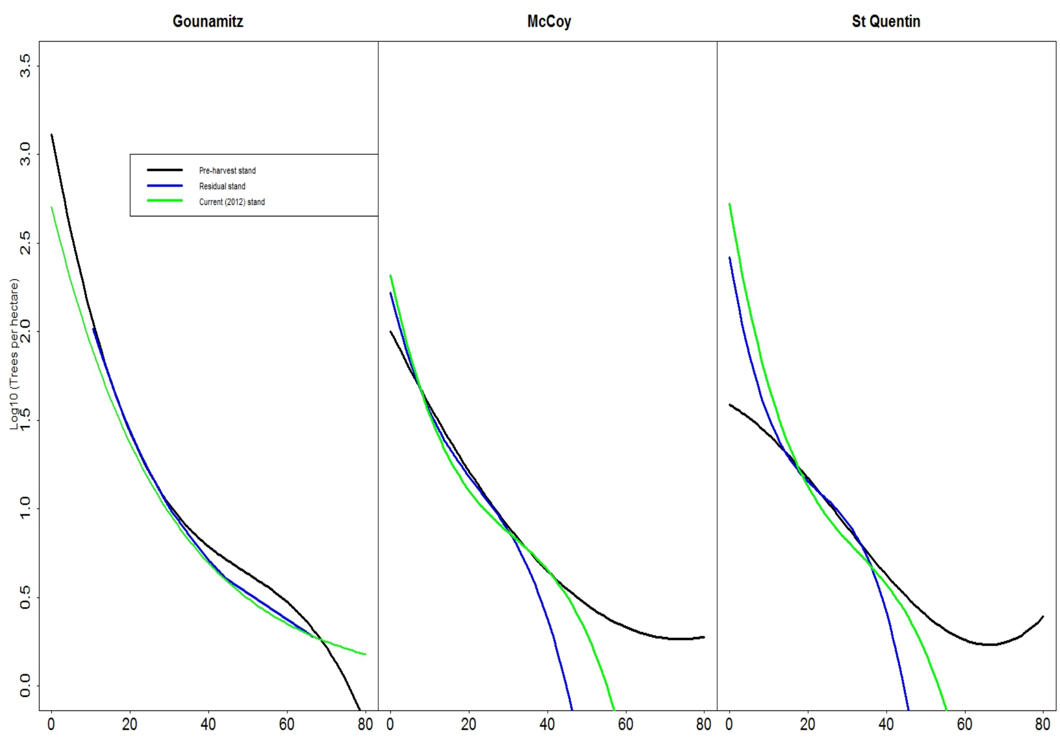


Figure 2: Diameter distributions from Gounamitz, McCoy and St Quentin stands plotted on semi-logarithmic axes to show the variation in curve shapes.



Prior to the last harvest, tree density in all studies were generally higher compared with the stands measured in 2012 (Figure 1). The last harvest changed diameter distributions in all the stands (Figure 2). Diameter distribution changed from rotated sigmoid form to concave at Gounamitz stand after the last harvest reduced the stocking level to 15.6 m^2/ha. Diameter distributions at both McCoy Brook and St-Quentin showed opposite trend to that at Gounamitz study area.

It is without questioning that the stands would be different at the time of harvest (1996) and at the time of survey (2012) by diameter distribution, as we just seen, but also in species composition in the overstory BA depending on the cutting technique exploited. At Gounamitz and McCoy sites, sugar maple and yellow birch were the dominating species in 1996, and only sugar maple was dominant at the site in St-Quentin. By 2012, Gounamitz site had lower sugar maple and yellow birch dominants and newly red maple proportions in the overstory BA. McCoy site has seen increasing proportions of both of its dominant species. For St-Quentin, sugar maple proportions increased exponentially with red maple as other hardwood and yellow birch declined. Table 1 resumes the proportions of the dominant and other species in the overstory BA of these three stands. In general, cumulative DBH growth of sugar maple was slower than red maple and yellow birch trees (Figure 3 on next page). Overall, yellow birch showed the fastest DBH growth among the three, even it reached breast height after sugar maple and red maple.

Table 1: Dominant species composition in the stands at time of harvest (1996) and at time of survey (2012).

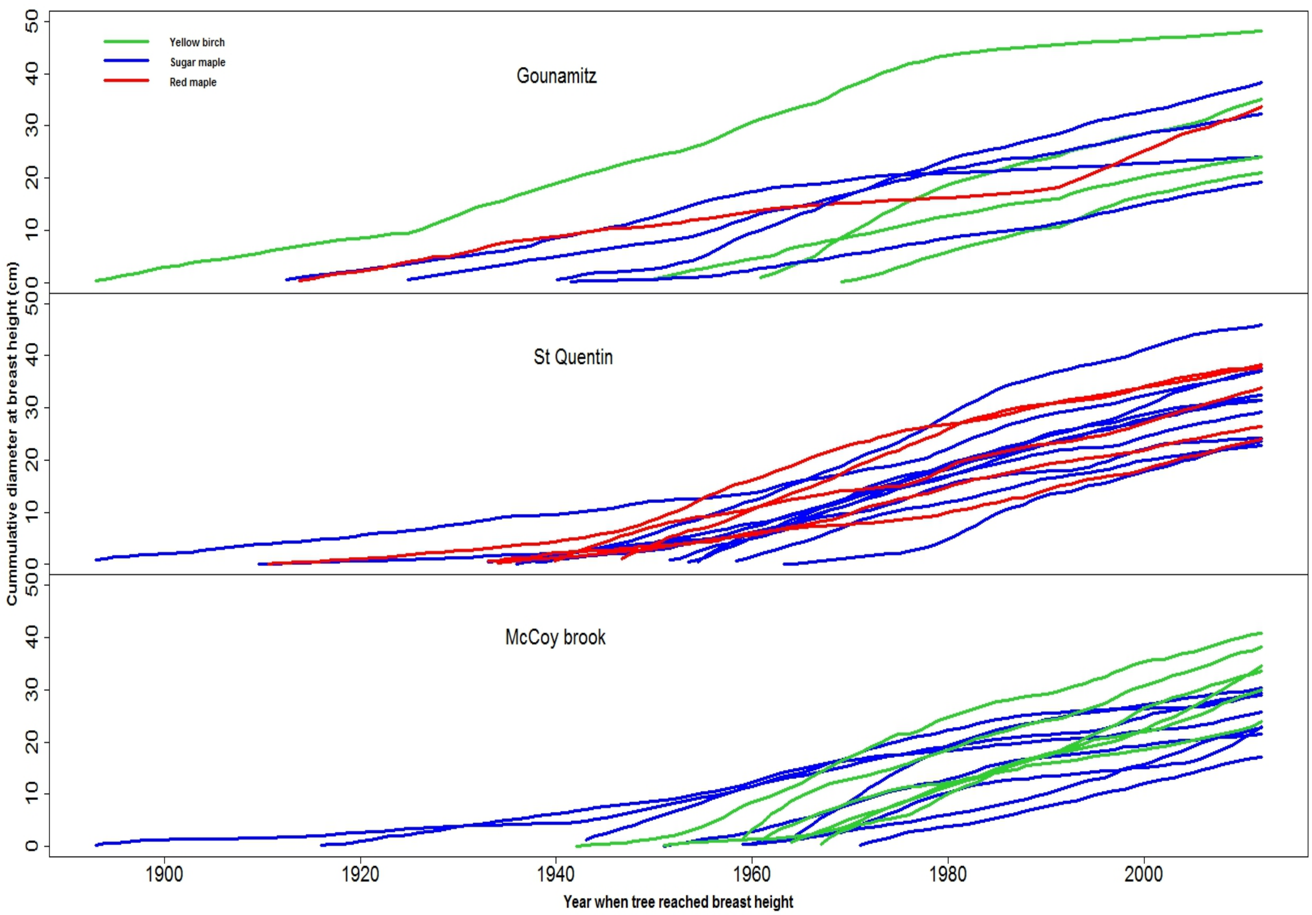
Site	Species	1996	2012	Proportions
Gounamitz	SM	43.2 %	40.0 %	Lower
	YB	37.3 %	34.3 %	Higher
	RM	0 %	10.4 %	Higher
McCoy	SM	37.1 %	46.5 %	Higher
	YB	41.5 %	42.4 %	Higher
St-Quentin	SM	55.3 %	77.3 %	Higher
	OTHW	18.3 %	2.5 %	Lower
	RM	12.0 %	17.8 %	Higher
	YB	1.9 %	0 %	Lower

Conclusion

The pre-1996 stands had high tree densities and large diameter (DBH > 50cm) trees were generally more than the current stand. The last harvest at Gounamitz shifted the diameter distribution to a sustainable form. The stands observed in this study were generally dominated by tolerant hardwood species and maintained this composition 16 years after the last harvest. However, species composition at the St-Quentin study area shifted to sugar maple tolerant hardwood in the current stand.

In general, yellow birch and red maple showed rapid diameter growth, even when these species reach breast height later than sugar maple. Sugar maple advance regeneration survived longer periods of time in the understory but these trees either formed large branches within the first 5m of the main stem or were at risk of losing vigor (F3 and R3 or worse based on New Brunswick Tree Classification System) in the 2012 stand. It would be advisable to thin out these sugar maple understories to reduce competition, thus ameliorating the quality of their wood (less damage and less risk of losing vigour) and augmenting their future value (more merchantable bole length and less discolouration).

Figure 3: Cumulative diameter growth patterns of sugar maple, yellow birch and red maple. Each line represents a single tree.



References

Allen, C.D., Savage, M., Falk, D. a, Suckling, K.F., Swetnam, T.W., Schulke, T., Stacey, P.B., Morgan, P., Hoffman, M., Klingel, J.T., 2002. Ecological Restoration of Southwestern Ponderosa Pine Ecosystems: a Broad Perspective. Ecol. Appl. 12, 1418–1433.

Boucher, Y., Arseneault, D., Sirois, L., 2006. Logging-induced change (1930-2002) of a preindustrial landscape at the northern range limit of northern hardwoods, eastern Canada. Can. J. For. Res. 36, 505–517. doi:10.1139/x05-252.

Deal, R.L., Oliver, C.D., Bormann, B.T., 1991. Reconstruction of mixed hemlock-spruce stands in coastal southeast Alaska. Can. J. For. Res. 21, 643 – 654.

Dupuis, S., Arseneault, D., Sirois, L., 2011. Change from pre-settlement to present-day forest composition reconstructed from early land survey records in eastern Québec, Canada. J. Veg. Sci. 22, 564–575. doi:10.1111/j.1654-1103.2011.01282.x

Foster, D.R., Orwig, D. a., McLachlan, J.S., 1996. Ecological and conservation insights from reconstructive studies of temperate old-growth forests. Trends Ecol. Evol. doi:10.1016/0169-5347(96)10047-1

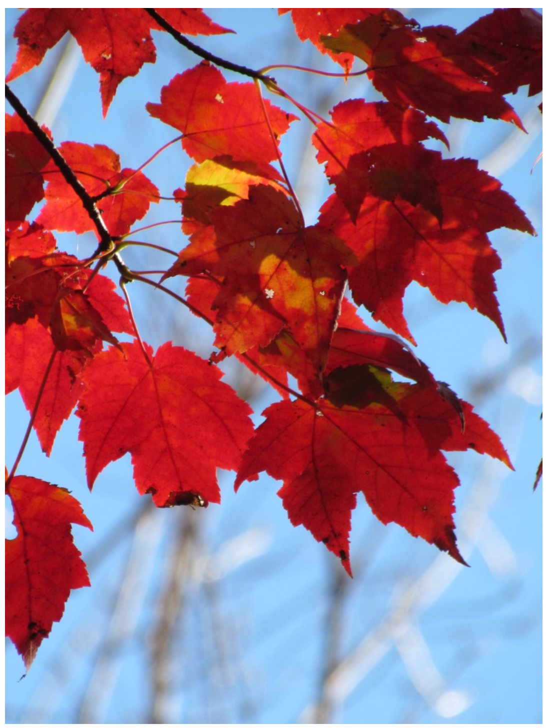
Hagmann, R.K., Franklin, J.F., Johnson, K.N., 2013. Historical structure and composition of ponderosa pine and mixed-conifer forests in south-central oregon. For. Ecol. Manage. 304, 492–504. doi:10.1016/j.foreco.2013.04.005.

Harrod, R.J., McRae, B.H., Hartl, W.E., 1999. Historical stand reconstruction in ponderosa pine forests to guide silvicultural prescriptions. For. Ecol. Manage. 114, 433–446. doi:10.1016/S0378-1127(98)00373-9.

Romme, W., Wiens, J., Safford, H., 2012. Historical ecology and historical range of variation, in: Wiens, J.A., Hayward, G.D., Safford, H.D., Giffen, C. (Eds.), Historical Environmental Variation in Conservation and Natural Resource Management. Wiley and Sons Ltd, Chichester, UK, pp. 1 – 6.

Acknowledgement

We would like to thank the Retrospective Project Planning team, Acadia Timber Inc. and New Brunswick Department of Natural Resources for their assistance in the study. We are grateful to many Northern Hardwoods Research Institute past and present members and former and current students of the School of Forestry at Université de Moncton who helped with field and lab works.



For more informations, contact:

Gabriel Danyagri

info@hardwoodsnb.ca

Institut de recherche sur les feuillus nordiques Inc.
Northern Hardwoods Research Institute Inc.